DOSEWALLIPS RIVER BRIDGE **HAER No. WA-94**

U.S. Route 101 spanning the Dosewallips River
Brinnon
Jefferson County
Washington

HAER
WASH
16-BRIN,
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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
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Location:	U.S. Route 101, spanning the Dosewallips River, Brinnon, Jefferson County, Washington, beginning at mile point 306.65.
	UTM: 10/507460/5281660
	Quad: Brinnon, Washington
Date of Construction:	1923
Engineer:	Washington Department of Highways.
Fabricator:	Ward & Ward, Inc., for the U.S. Bureau of Public Roads
Owner:	Originally U.S. Department of Agriculture, Bureau of Public Roads. By 1941 Washington Department of Highways. From 1977, Washington State Department of Transportation.
Present Use:	Vehicular and pedestrian traffic.
Significance:	The Dosewallips River Bridge is an example of a riveted through Pettit truss with sub-struts and polygonal top chord (Pennsylvania truss). It is possibly the earliest example of the standard 240' truss design devised by the Washington State Department of Highways in the period 1920-1922.
Historian:	Jonathan Clarke, August 1993.

History of the Bridge

On 4 August 1922, Washington State Department of Highways applied for Federal Aid for the construction of a bridge and approach roads across the Dosewallips River in Jefferson County. The bridge was to form one part of a program of many improvements and construction projects on the Olympic Highway, a primary route circumnavigating the Olympic Peninsula and now designated as U.S. 101. Federal aid was granted on 30 September 1922, but unlike the majority of other projects which were funded under the usual provisions of the Federal Aid Road Act, through the Bureau of Public Roads. Sections of the proposed improvements to the Olympic Highway eastern passed through the Olympic National Forest, and those construction projects within this territory were the automatic responsibility of the U.S. government, with financing coming from the Bureau of Public Road's Forest Road Funds. This arrangement was particularly beneficial to the Washington Department of Highways because under an amendment of the Federal Road Aid Act, approved in November 1921, those projects eligible for standard federal funding could receive only a maximum of 50 percent of the total estimated construction costs from this source.[1]

On 29 September 1922, the first notice to contractors for the construction of "one 240' steel truss bridge with 2-32' concrete approach spans" appeared in *Pacific Builder and Engineer*. The contract form and maps, plans, specifications and estimates of quantities were available for inspection at the District Engineer's Office, Bureau of Public Roads, Portland, Oregon, office; the Olympic National Forest Supervisor's office; and the Washington Department of Highways in Olympia. The work was to be executed in 180 weather-working days following the execution of the contract by the Secretary of Agriculture.[2]

The contract was awarded, probably on 10 October 1922, to Ward and Ward, Inc. for an estimated contract price of $50,000. [3] The actual date of completion of the project is not known, but it seems likely that this was in the following summer, given the 180 working-day contractual clause. Including the approach roads, the project amounted to half a mile in length.[4]

The construction of the bridge was significant because it was based on a standard design for a 240' through truss with a 20' roadway and concrete floor. From 1920 the state highway department began a policy of standardizing bridge plans as much as possible, so that their preparation and the accompanying estimates for particular situations could be expedited at comparably less cost. It also reduced the amount of unnecessary duplication in design. Smaller spans naturally lent themselves to this process more easily, but by 1920-22, three longer spans of 90′ upwards had been prepared. These were all steel through trusses, and were designed in lengths of 90′, 130′, 140′, and 240′. All were designed with 20′ clear roadways between curbs, which permitted the passing of three automobiles in an emergency, and all conformed to "class A" loading, meaning they were capable of supporting a moving 20-ton truck and an impact allowance of 15 percent on top of this. By 1922-24, standard steel spans for the lower class 'B' loading were on file and the number in the class 'A' category had grown dramatically: a virtual catalogue of twelve designs, covering the span range 90′ to 262′, was available by this stage. Moreover, besides the state highway department, the counties were now at liberty to use them at no cost.[5]

The Dosewallips bridge was one of, if not the first bridge to be built aooording to the 240′ span standard bridge design. The plans, drawn up by the Bridge Department in Olympia, were presumably appropriated by the Bureau of Public Roads for the sake of simplicity and economic rationality: at a cost of $50,000 this bridge was extremely cost-effective. The Bureau of Public Roads was to repeat this scenario almost identically in June 1924 for another National Forest Road Project: the building of Bogachiel River Bridge in Clallam County, also along the Olympic Highway or State Road No. 9 as it was now designated. This too was a standard 240′ steel truss, identical to the Dosewallips River Bridge except in approaches. This bridge, which was contracted to J. W. Sadler & Company, Portland, Oregon, is no longer extant.[6]

Design and Description

The Dosewallips River Bridge consists of a 240′ riveted through Pettit truss with sub-struts and polygonal top chord (Pennsylvania truss) flanked on either side by a 31′-6" reinforced concrete T-beam approach span. The main span, which is aligned north-south on a slight tangent to the river, rests on two concrete dumb-bell piers, each composed of two cylindrical piers connected by a solid web. The bridge rests on a roller bearing on the south pier and a cast steel pedestal on the north pier. Both sets of pier shafts are 18′ high, set on 22′-10" centers, and are equipped with spread footings that rest on timber piles. Either pier is also shared by the ends of the approach span, the roadway of which is supported by four equally spaced concrete T-beams which curve downwards (hunched) at either end into the piers and four column abutments respectively. The roadway of both approach spans is flanked by a concrete railing with spandrel balusters.

The steel truss is divided into 12 panels, each 20′ in length. The polygonal upper chord, the major compression member in the truss, is made up of 12 built-up members. Each comprises two 15" rolled channels riveted together by a 22-3/8" cover plate on the upper flanges, and by lacing on the lower flanges. The lower chord, the major tension member, is made up of two channels of the same depth: for the outer three panels (L0-L3) these are connected by batten plates; for the inner panels (L4-L5) 12" x 3/8" cover plates are used; and for the central panels (U5-U6) cover plates of the same width but marginally thicker (7/16") are used.

Supporting the upper chord are six verticals or posts, each a single composite member. These are positioned between points U1-L1, U3-L3, and U5-L5. They are built up of four angles, 5" x 3" x 5/16", connected by lacing riveted in the inside of the flanges.

Ten other vertical members, termed sub-struts, are used to support the top chord at mid-panel length. They extend down as one member from the top chord to the intersection of the diagonals, and then proceed as another down to the bottom chord. The five upper sub-struts, connecting points U2-M2; U4-M4; U6-M6; U4′-M4′; U2′-M2′ are relatively light, made up of four angles 3" x 2-1/2" connected on their inside flanges by lacing. The steel used for the central strut is slightly thicker than that used for the rest: 5/16" compared to 1/4". The five lower sub-struts, connecting points M2-L2; M4-L4; and M6-L6, are more robust, composed of two angles measuring 5" x 3" x 5/16", connected by batten plates.

Only two diagonals extend unbroken between the upper and lower chord. These are located between points U3-L5 and U3′-L5′. They are made up of two 9" rolled channels, their webs apart, riveted together by lacing on the outside of the flanges. All other diagonals are sub-members, connecting the upper chord and the lower chord at the junction of the sub-struts. The sub-diagonals between points L1-M2; L3-L4; L1′-M2′ and L3′-M4′ are all composed identically to the verticals--four angles, 5"x 3"x 5/16", connected by lacing on the inside of the flanges. Four horizontal sub-diagonals between points M4-M3; M6-M5; M4′-M3′; and M6-M5′ are composed in an identical manner, although the angles used are more slender, measuring 3" x 2-1/2". The diagonals in the central two panels, between U5-M6; M6-L5; U5′-M6′; M6′-L5′ are made up of two 8"channels connected by lacing. Those in the outer panels, between U1-M2 and U1′-M2′; and M2-L3 and M2′-L3′, employ four angles 6" x 3-1/2" x 5/16", the former connected by a cover plate on the inside of their flanges and the latter by batten plates. The diagonal members counteract the tensile forces acting within the truss, and the robustness or slenderness of the particular member is loosely indicative of the relative degree of tension it is subject to.

The upper lateral bracing and struts both use slender angles, 3-1/2" x 2-1/2" x 1/4". In the former two are used, riveted together by lacing and intermittent batten plates. In the latter, four are used for additional rigidity, with the lacing sandwiched between the flanges. Lower lateral bracing is very light, employing only one angle, 3" x 2-1/2" x 5/16", for these members.

Sway bracing is fairly elaborate, consisting of two diagonals intersecting at their midpoint and connecting opposite sides of the truss, with further members connecting the midpoint of the lower strut and the top strut with their respective adjacent verticals. All members, with the exception of the lower strut, are made up of one angle, 3' x 3" x 5/16". The lower strut is made up of two angles, 3" x 3-1/2" x 5/16".

Portal bracing consists of a upper and lower portal strut, braced by four diagonal members in a warren configuration. All these members consist of four angles measuring 3" x 2-1/2" x 1/4", connected by lacing sandwiched between the flanges. Both the Portal bracing and sway bracing have been modified in recent years (see Maintenance below).

Thirteen section-steel floor beams, made up of four angles (4" x 6" x 1/2") and a web plate (27" x 7/16"), support eight lines of rolled I section stringers, each 20' long with a 15" web, spaced 2'-10" apart. On top of this is 6" thick reinforced concrete deck, equipped with a 1/4" expansion joint in the curb. The concrete roadway itself is 20' wide between curbs.

No sidewalk was provided for in the original design, but in 1963, as a result of unspecified requests to the district engineer--probably park visitors--this was built. It consists of a series of steel angle frames welded to the lower, east chord gusset plates, which support creosoted timber stringers and wood planking.[7]

The adoption of a Pennsylvania (Pettit) design by the Washington Department of Highways for its standard 240' steel bridge is perhaps not surprising given the eminent suitability of this truss type for spans of this length or greater. This form first evolved in the 1870s as a modification of the phenomenally successful Pratt truss, where the utilization of sub-struts or sub-ties with a polygonal top chord resulted in a significantly stronger structure greatly suited for longer spans. It enjoyed extensive use on the Pennsylvania Railroad in the late nineteenth century on account of its ability to sustain heavy live loads, and this is how it derived its name. Furthermore, unlike many other truss forms, many of which became increasingly obsolete as the twentieth century progressed, this form was comparatively simple, lent itself well to the standardization of shop parts, and like the Pratt truss, was economical of metal, although only for longer spans. According to J.A.L. Waddell, a renowned early twentieth century Bridge Engineer, the use of sub-divided panels in highway bridges where the panels were not much longer than 20' in length, ceased to be economical for spans under about 225' to 250'.[8] At 240', it seems likely the Dosewallips River Bridge, the Bogachiel Bridge and others that were built to the standard Petit design at this time represented the lower limit for the feasibility of this form; for shorter standard steel spans, the basic Pratt was probably adopted.

Repair and Maintenance

Apart from periodic re-painting of the steelwork, the Dosewallips River Bridge remained in good condition until 1966, requiring no other repairs.

In 1967 it was noticed that the roller nest on the South pier was loose and required tightening. This was undertaken by 1969, when no further mention was made of it, at least for the time being, in the Bridge Inspection Reports. In the following year the underside of the lower chord was scraped and the bottom lateral bracing was bent slightly in that portion crossing over the National Park access road on the south side embankment. It was caused by a high load, probably a park truck. The damage however was deemed too minimal to warrant repair.

The year 1969 saw the first instance of a problem that was to recur with alarming frequency: damage to the portals and/or sway bracing because of insufficient vertical clearance for loads exceeding the 14' legal height limitation. Then, the south portal bracing and first sway in from this end was nicked, and one of the sway frames was badly bent. These damaged sections were repaired by the following year. In 1974 another, more severe, collision damaged both portals and two sway frames. This necessitated the replacement of a number of the central angles in the south portal, the heat straightening and splicing of the sway frame immediately in from this, and similar repair to both the north portal and corresponding sway frame. This was undertaken in the following year.

Another collision occurred in 1979, which bent the north portal slightly and rotated one of the gusset plates. The sway framing was thus raised to the lower intersection of the diagonal braces, a rise of 1'-8-3/4". The following year showed that this was not enough, for at some point in the year the first sway in from the south portal was forced northwards by 8". The 1981 Bridge Inspection Report noted that all the sways had been pushed northwards. A severe collision in 1984 however precipitated more lasting action. Both entry portals were raised and the first sway frame from either end was raised. This action was taken after it was determined that it would not affect the structural integrity of the bridge. This modification accompanied a fairly widespread program of portal/sway framing raising on truss bridges in this maintenance district at this time. All were prompted by a large number of recent high load hits: those affected had a clearance of only a few inches in excess of the 14' height limit for vehicles. Following this action, the Dosewallips River Bridge suffered further collision damage in 1991, necessitating repair to a damaged end post.[9]

The only other potentially serious, persistent problems were the loose expansion plate at the South end, hairline cracking of the concrete T-beams of either approach, and wearing and cracking of the deck. The roller nest, which rattled with the passing of traffic, was firmly re-anchored by 1983. The other problems have to date not merited specific repairs. The life expectancy for the bridge is presently 2005.[10]

Data Limitations

This bridge received no coverage in the engineering literature. The *Engineering Index* made no mention of it, while a perusal through the more regional enginsering journal--the *Pacific Builder and Engineer* for the year 1923 yielded only limited contractual information from the former (see bibliography). This journal is available for immediate consultation in Seattle Public Library.

With regard to construction of the historical context of the bridge, the Department of Highways *Biennial Report* provided some useful information. No newspaper article citations were found in the card indexes of either the Northwest Room of the Washington State Library, Olympia, or the Washington State Historical Society, Tacoma.

The (incomplete) set of plans held on microfilm at Records Control, Washington Department of Transportation Building, Olympia, Washington, together with the information held on the "Kardex" file at the Bridge Preservation Section, Olympia, proved particularly useful in describing the structure.

Project Information

This project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States. The Washington State Historic Bridges Recording Project was co-sponsored in 1993 by HAER, the

Washington State Department of Transportation (WSDOT), and the Washington State Office of Archeology & Historic Preservation. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Robert J. Kapsch, Ph.D., Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; and Dean Herrin, Ph.D., HAER Staff Historian.

The recording team consisted of Karl W. Stumpf, Supervisory Architect (University of Illinois at Urbana-Champaign); Robert W. Hadlow, Ph.D., Supervisory Historian (Washington State University); Vivian Chi (University of Maryland); Erin M. Doherty (Miami University), Catherine I. Kudlik (The Catholic University of America), and Wolfgang G. Mayr (U.S./International Council on Monuments and Sites/Technical University of Vienna), Architectural Technicians; Jonathan Clarke (ICOMOS/Ironbridge Institute, England) and Wm. Michael Lawrence (University of Illinois at Urbana-Champaign), Historians; and Jet Lowe (Washington, D.C.), HAER Photographer.

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"Where the Dosewallips River Flows Into Hood Canal." *Tacoma News Tribune*, 16 October, 1966, B8.

ENDNOTES

[1] Washington Department of Highways, *Ninth Biennial Report of the Supervisor of Highways, 1920-1922*, 12-13, 72, 121; Washington Department of Highways, *Tenth Biennial Report of the Supervisor of Highways, 1922-1924*, 118.

[2] C. H. Purcell, "Dosewallips Bridge, Adjacent To Olympia National Forest, State of Washington [Notice to Contractors]" *Pacific Builder and Engineer* 28 (29 September 1922): 27.

[3] "Dosewallips River Bridge, No. 101/262," Kardex Card File, Bridge Preservation Section, Washington State Department of Transportation, Olympia, WA [WSDOT]; Purcell, "Dosewallips Bridge, Adjacent To Olympia National Forest, State of Washington [Notice to Contractors]," 27. This notice states that bids will be opened on 10 October 1922, but it is not know for certain whether this actually occurred.

[4] Washington Department of Highways, *Ninth Biennial Report of the Supervisor of Highways, 1920-1922*, 71.

[5] Ibid., 31-33; Washington Department of Highways, *Tenth Biennial Report of the Supervisor of Highways, 1922-1924*, 32-33.

[6] Washington Department of Highways, *Tenth Biennial Report of the Supervisor of Highways, 1922-1924*, 79.

[7] Department of Agriculture, Bureau of Public Roads, "Plans For Proposed Dosewallips River Bridge, Olympic Highway, National Forest Road, Adjacent to Olympic National Forest, Jefferson County, Washington [8 Sheets]," Contract No. Approved 27 September 1922, held by Records Control, WSDOT; "Dosewallips River Bridge, No. 101/262," Kardex Card File, Bridge Preservation Section, WSDOT; "Dosewallips River Bridge, No. 101/262," Bridge Inspection Reports (1945-91), Bridge Preservation Section, WSDOT.

[8] J. A. L. Waddell, *Bridge Engineering*, vol. 1 (New York: John Wiley & Sons, 1916), 468-70, 480.

[9] "Dosewallips River Bridge, No. 101/262," Bridge Inspection Reports (1945-91), Bridge Preservation Section, WSDOT.

[10] Ibid.